

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY



(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 25 JAN 2006

See Form PCT/PEA/416

PCT

Applicant's or agent's file reference P2247PC00-TO		FOR FURTHER ACTION	
International application No. PCT/NO2004/000353	International filing date (day/month/year) 17.11.2004	Priority date (day/month/year) 21.11.2003	
International Patent Classification (IPC) or national classification and IPC E21B21/00			
Applicant AGR SERVICES et al.			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 11 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand  19.05.2005		Date of completion of this report  24.01.2006	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer Diaz y Diaz-Caneja, Telephone No. +49 89 2399-7534 	

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/NO2004/000353

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

**Description, Pages**

1-7 received on 13.01.2006 with letter of 11.01.2006

**Claims, Numbers**

1-12 received on 13.01.2006 with letter of 11.01.2006

**Drawings, Sheets**

1/5, 2/5, 5/5 as originally filed

3/5, 4/5 received on 13.01.2006 with letter of 11.01.2006

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/NO2004/000353

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	1-12
	No: Claims	
Inventive step (IS)	Yes: Claims	1-12
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-12
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

PCT/NO2004/000353

- 1) A device with the features of the preamble is known from D1: US-A-4 410 425.

The problem may be regarded as how to reduce the consumption of costly drilling fluid in drilling operations offshore.

This problem is solved in the known device with the features described in the characterising part of claim 1. In particular it is not known from the searched prior art documents a plug of drilling fluid being at the top of the suction module so that the drilling fluid can be recovered without being mixed with the sea water.

Therefore, the skilled person had no incentive to include such feature in the known device in order to solve the problem posed. Consequently, the subject-matter of claim 1 meets the requirements of Art. 33(2)-(4) PCT..

Device for removal and filtration of drilling fluid.

5 The present invention relates to a device for removal and filtration of drilling fluid in top hole drilling, where a suction module comprises an elongated pipe-formed body which is open at the top and is arranged to an ocean-bottom penetrating pipe, through which is led a drill stem for drilling of the top hole, and the pipe-formed body comprises a filtration device with through openings, where said openings are arranged to let through to at least one outlet passage  
10 in the pipe wall, filtered return drilling fluid containing dispersed material, such as swelling clay or stones,

15 In connection with drilling operations (top hole) offshore, there are regions where the geological conditions result in that in many areas the formation is such that top holes must be drilled with an expensive, water-based drilling fluid, or a synthetic drilling fluid, for example KCl/Glycol drilling mud. Such drilling fluid has a typical cost of 1500 – 2000 NOK/m<sup>3</sup> and up to 10 000 m<sup>3</sup> can be needed for a single top hole. In addition, there are large logistics costs as these amounts of fluid are used during a period as short as 48 hours and must often  
20 be transported large distances.

Therefore, it is a wish to try to reduce this consumption of costly drilling fluid in that the drilling fluid is recycled.

25 The present invention, which can be called a suction module (SMO) or a collection module, has a suction chamber to which the suction pipe of the pump is connected. This can be called a "particle trap/gumbo trap" to prevent that the suction pipe is blocked during drilling in swelling clay. The advantage with this solution is that large stones (boulders) and clumps of swelling clay (gumbo) can  
30 be pumped over the top of the SMO without the suction pipe of the pump becoming blocked, with the subsequent stop of the drilling operation. The particle trap is equipped with filtration equipment that prevents large particles from entering the pump and damaging or possibly blocking it. The filtration equipment has preferably openings that are adjusted to the internal openings of  
35 the pump, typically 5-8 cm. During drilling, the capacity of the pump can be regulated so that a plug/a volume of drilling fluid is in the SMO, or slightly less than what comes up from the drill hole can be pumped so that there is a small overflow over the top of the SMO all the time. In this way, 80-90% of the drilling

fluid can be recovered without the mixing in of seawater. At failure of the pump the drilling operation can continue as usual with discharge to the sea ("pump and dump").

- 5 The SMO can be used on "single slot" wells, i.e. detached production wells or exploration wells, as well as on templates with several wells.

The present invention can be used in connection with solutions that are described in the applicants own Norwegian patents, NO 308.043 and NO  
10 312.915, either as a replacement for the solutions described therein or in combination with the described solutions.

From known technology, US 4,149,603 can be pointed out among others. This system shows a solution where use of a riser is eliminated at drilling operations  
15 under water. The system comprises a pump which can be connected to the upper part of an underwater drilling hole and has a lower part with an inlet and an upwardly extending wall which cooperates with the lower part, and also means to prevent water coming in contact with the upper part of the cuttings  
20 only, as the cuttings pass upwards from the lower inlet. The cuttings are further transported to the surface with the help of a pump, via a pipe.

US 4,410,425 disclose an apparatus for filtering drilling mud and cuttings that are brought to the well so that the mud can be being recirculated. The document does not teach that an outlet opening is connected to a suction  
25 module or a pump.

The object of the present invention is to provide a solution which transports return drilling fluid away from a well that is drilled at top hole drilling, and also that any drilling fluid that is used in the drilling can be recycled to be used in the  
30 same drill hole or in another drill hole. It is also an object to provide a solution that result in drilling fluid, which is delivered to a pump, containing particles that do not cause any damage to the pump.

This object is obtained with a device according to the invention, and which is  
35 characterised by the independent claim 1, in that filtered return drilling fluid from the bore hole is exported to a pump module through the at least one outlet passage in the pipe wall, where the material in the drilling fluid is of a size less than the diameter of a inlet pipe of the pump or openings of the pump, and that

the upper part of the pipe-formed body is arranged to contain return drilling fluid, which is not fed to the pump module, and where the level/volume of said drilling fluid stands as a "plug" above the outlet for the pumps suction pipe and is arranged to seal against the drill stem.

5

Preferred embodiments are characterised by the dependent claims 2-12.

For example, the level/volume of return drilling fluid in the pipe-formed body can be arranged to be adjusted by regulation of the capacity of the pump.

10

The suction module can comprise a camera and/or a sonar for monitoring of the level of the drilling fluid, i.e. the "plug" of return drilling fluid, in the pipe-formed body, and the monitoring signals can be sent to an operator for regulation of the capacity of the pump.

15

The suction module can comprise measuring equipment for monitoring of the level of drilling fluid, i.e. the "plug" of return drilling fluid, in the pipe-formed body, and monitoring signals can be sent to an operator, or directly to the pump for regulation of the capacity of the pump.

20

The filtration device can comprise an inner, elongated and arched, perforated filtration plate where at least one annular space, or parts of an annular space that is closed at the top and/or at the bottom, is provided between the inner pipe wall of the pipe-formed body and the inner perforated filtration plate.

25

Preferable, an annular space extends in the whole, or parts, of the longitudinal direction of the pipe-formed body and/or its circumference.

The elongated, perforated filtration plate can be formed in the shape of a pipe.

30

Further, the pipe wall of the pipe-formed body can comprise a number of outlet passages arranged spaced apart radially around the pipe wall, where the outlet passages are connected to the suction pipe of the pump.

35

At least one of the outlet passages in said pipe wall is preferable connected to a suction manifold, and the suction pipe of the pump is connected to the suction manifold. The suction manifold can comprise a number of outlets with suction connection for the pump.

The suction module can comprise a lifting loop, or another appliance for connection of a lifting tool.

Furthermore, in an alternative embodiment the suction module and pump module can be integrated into each other.

5 The invention shall now be described in more detail with reference to the enclosed figures, in which:

Figure 1 shows an example of a system with floating drilling rig and a suction module and a pump arranged on the ocean bottom.

10 Figure 2 shows a template with several suction modules connected to a pump, and also associated pipes.

Figure 3 shows an embodiment example of a suction module with a device according to the present invention.

Figure 4 shows a second embodiment example of a suction module with a device according to the present invention.

15 Figure 4a shows a crosswise section along the line A-A in figure 4.

Figure 4b shows a partially longitudinal section, in an area corresponding to that shown in figure 4a.

Figure 5 shows an example of a suction module and a pump placed on the ocean bottom.

20

Figure 1 shows an example of a system which uses a device according to the invention. In the example shown in figure 1, the rig is not shown to scale in relation to the equipment placed on the ocean bottom.

25 Top hole drilling is carried out at the start of drilling a bore hole, and is carried out before a blow-out protection (BOP) is fitted on a wellhead and a riser is mounted between the rig and the bore hole. As figure 1 show, a floating drilling rig 14 is placed above the bore hole on the ocean bottom, from where a drill stem 16 extends from the floating drilling rig 14 down to the bore hole and  
30 which runs through a suction module 10 according to the invention. That a floating drilling rig is shown is only as an example, a floating drilling vessel or a drilling rig which stands on the ocean bottom can also be used.

35 As mentioned, figure 1 shows the suction module 10 according to the invention, where a pipe or pipeline 22 for transport of drilling fluid that comes in return from the well which is being drilled extends from an outlet on the suction module to a pump module 12 that is arranged separately from said suction module. A cable 18 extends between the drilling rig 14 and the pump module



for lowering and hoisting of the pump module and also for the supply of power to the pump engine and any other drive units, and also for control signals. In the example shown, a return pipe 20 for drilling fluid extends from the pump module 12 to the drilling rig 14. The drilling rig can comprise equipment for recovery of the return drilling fluid so that recovered drilling fluid can be used during drilling of the same well or another well which is being drilled or is to be drilled. The equipment for recovery of drilling fluid is known by people skilled in the arts and will therefore not be described in more detail in this application. In the examples shown, the suction module and the pump module are shown arranged separately from each other on the ocean bottom, but alternatively can also be integrated with each other to make up one unit. Another embodiment can be that the pump module hangs a distance above the ocean bottom, for example, in that it hangs in the pump return pipe.

Figure 2 shows another example of a system with a suction module 10 according to the present invention. The system primarily comprises the same main components as shown in figure 1, apart from that the return pipe 20 does not extend up to the drilling rig 14, but to another location on the ocean bottom to deposit return drilling fluid onto the ocean bottom. The object of depositing return drilling fluid at another location on the ocean bottom is, among other things, to improve visibility for ROV (remote controlled submarine vessel), visibility for monitoring equipment, reduce the pollution around the template etc. There is also a requirement from the authorities to reduce the pollution on the ocean bottom in connection with drilling of wells. Of course, the same objectives will be relevant for the system shown in figure 1.

As shown in figure 2, a template 24 is placed on the ocean bottom. In the example shown there are three openings and two suction modules 10 according to the invention. Of course, there can be more or fewer openings and suction modules. The pipeline 22 for return drilling fluid extends from the suction module to the pump module 12 and, as mentioned, the return pipe 20 extends from the pump 12.

The invention comprises a suction module 10 placed on a template 24, where the template comprises downwardly extending elements or skirts for anchoring to the ocean bottom. The suction module further comprises an elongated pipe-formed body 30, where the body 30 can be composed of one or more modules. Figure 3 shows a suction module with several extension modules, while figure 4

shows a suction module without such extension modules. The object of the extension modules is, among other things, to make it possible to regulate the level/volume of amount of return drilling fluid which is in the pipe-formed body 30. The pipe-formed body is arranged to an ocean-bottom penetrating pipe, such as a casing, and is preferably open at the top and the bottom.

The pipe-formed body 30 comprises at least one outlet passage 32. With more than one outlet passage, the outlet passages are preferably arranged radially and with mutual distance apart around the pipe wall of the pipe-formed body. Preferably arranged to the outlet passage(s) 32 is a suction manifold 34, which can have one or more outlets 36 with suction connections for the pump. As mentioned, the pipeline 22 is arranged between the suction connection and the pump module. The suction manifold 34 is not required for the realization of the invention, but is preferably used if there are several outlet passages 32 and/or several outlet/suction connections 36.

The suction module 10 also comprises monitoring equipment for the monitoring of the level of return drilling fluid in the pipe-formed body 30. For example, this can be a camera 38, a sonar, or similar equipment. Measuring equipment can also be arranged internally in the pipe-formed body to measure the weight and thus the height of the fluid column that stands in the body.

As mentioned, the present invention relates to a device for removal of drilling fluid in top hole drilling, where a suction module 10 comprises an elongated pipe-formed body 30 which is open at the top and is arranged to an ocean-bottom penetrating pipe, through which a drill stem 16 is led for drilling of the top hole, and where the pipe-formed body 30 comprises at least one outlet passage 32 in the pipe wall for export of return drilling fluid from the bore hole to the pump module 12. To prevent that the suction pipeline 22 is blocked during drilling in swelling clay, the suction module 10 according to the invention is equipped with a filtration device with through openings that prevent large particles from entering the pump and damaging or possibly blocking it. For example, this can be obtained by the pipe-formed body 30 comprising an inner elongated and arched perforated filtration plate 40, where the perforations of the inner filtration plate are arranged to let through, to at least one outlet passage 32, return drilling fluid containing disperse material, such as swelling clay and stones, of a size which is less than the diameter of the inlet pipe of the pump or the openings of the pump. Furthermore, the inner pipe wall of the pipe-

formed body 30 and the inner perforated filtration plate 40 provide at least one annular space that is closed at the top and/or bottom, where the annular space can extend in the whole or parts of the longitudinal direction of the pipe-formed body and/or in the pipe circumference. The perforated filtration plate 40 can  
5 preferably have a pipe shape.

The filtration device according to the invention can also be formed in other ways than described above. For example, an inner body with a grid-form, bar-form, etc, that is arranged to prevent particles of a certain size from passing through  
10 suitable openings, can be used. Other types of filtration devices can also be relevant, for example, a cyclone separator can be adapted for use in the suction module, arranged so that particles above a certain size are led up in the pipe-formed body, and that particles below a certain size are led to the outlet passage(s). The cyclone separator can also be arranged in the pipe-formed  
15 body, and/or be incorporated in connection with said annular space in the pipe-formed body.

CLAIMS.

1. Device for removal and filtration of drilling fluid in top hole drilling, where a suction module (10) comprises an elongated pipe-formed body (30) which is open at the top and is arranged to an ocean-bottom penetrating pipe, through which is led a drill stem for drilling of the top hole, and the pipe-formed body (30) comprises a filtration device with through openings, where said openings are arranged to let through to at least one outlet passage (32) in the pipe wall, filtered return drilling fluid containing dispersed material, such as swelling clay or stones, characterised in that filtered return drilling fluid from the bore hole is exported to a pump module (12) through the at least one outlet passage (32) in the pipe wall, where the material in the drilling fluid is of a size less than the diameter of an inlet pipe of the pump or openings of the pump, and that the upper part of the pipe-formed body (30) is arranged to contain return drilling fluid, which is not fed to the pump module (12), and where the level/volume of said drilling fluid stands as a "plug" above the outlet (32) for the pump's suction pipe (22) and is arranged to seal against the drill stem (16).
2. Device according to claim 1, characterised in that the level/volume of return drilling fluid in the pipe-formed body (30) is arranged to be adjusted by regulation of the capacity of the pump (12).
3. Device according to claim 2, characterised in that the suction module (10) comprises a camera (38) and/or a sonar for monitoring of the level of the drilling fluid, i.e. the "plug" of return drilling fluid, in the pipe-formed body (30), and that monitoring signals are sent to an operator for regulation of the capacity of the pump (12).
4. Device according to claim 2 or 3, characterised in that the suction module (10) comprises measuring equipment for monitoring of the level of drilling fluid, i.e. the "plug" of return drilling fluid, in the pipe-formed body (30), and that monitoring signals are sent to an operator, or directly to the pump (12) for regulation of the capacity of the pump.
5. Device according to any of claims 1-4, characterised in that the filtration device comprises an inner, elongated and arched, perforated filtration plate (40) where at least one annular space, or parts of an annular space that is

closed at the top and/or at the bottom, is provided between the inner pipe wall of the pipe-formed body (30) and the inner perforated filtration plate (40).

5 6. Device according to claim 5, characterised in that the annular space extends in the whole, or parts, of the longitudinal direction of the pipe-formed body (30) and/or its circumference.

7. Device according to claims 5 and 6, characterised in that the elongated, perforated filtration plate (40) is formed in the shape of a pipe.

10

8. Device according to any of claims 1-7, characterised in that the pipe wall of the pipe-formed body (30) comprises a number of outlet passages (32) arranged spaced apart radially around the pipe wall, where the outlet passages (32) are connected to the suction pipe (22) of the pump (12).

15

9. Device according to claim 8, characterised in that at least one of the outlet passages (32) in said pipe wall is connected to a suction manifold (34), and that the suction pipe (22) of the pump is connected to the suction manifold (34).

20

10. Device according to claim 9, characterised in that the suction manifold (34) comprises a number of outlets with suction connection for the pump (12).

25

11. Device according to any of claims 1-10, characterised in that the suction module (10) comprises a lifting loop (42), or another appliance for connection of a lifting tool.

12. Device according to any of claims 1-11,  
30 characterised in that the suction module (10) and the pump module (12) are integrated with each other.

FIG. 3

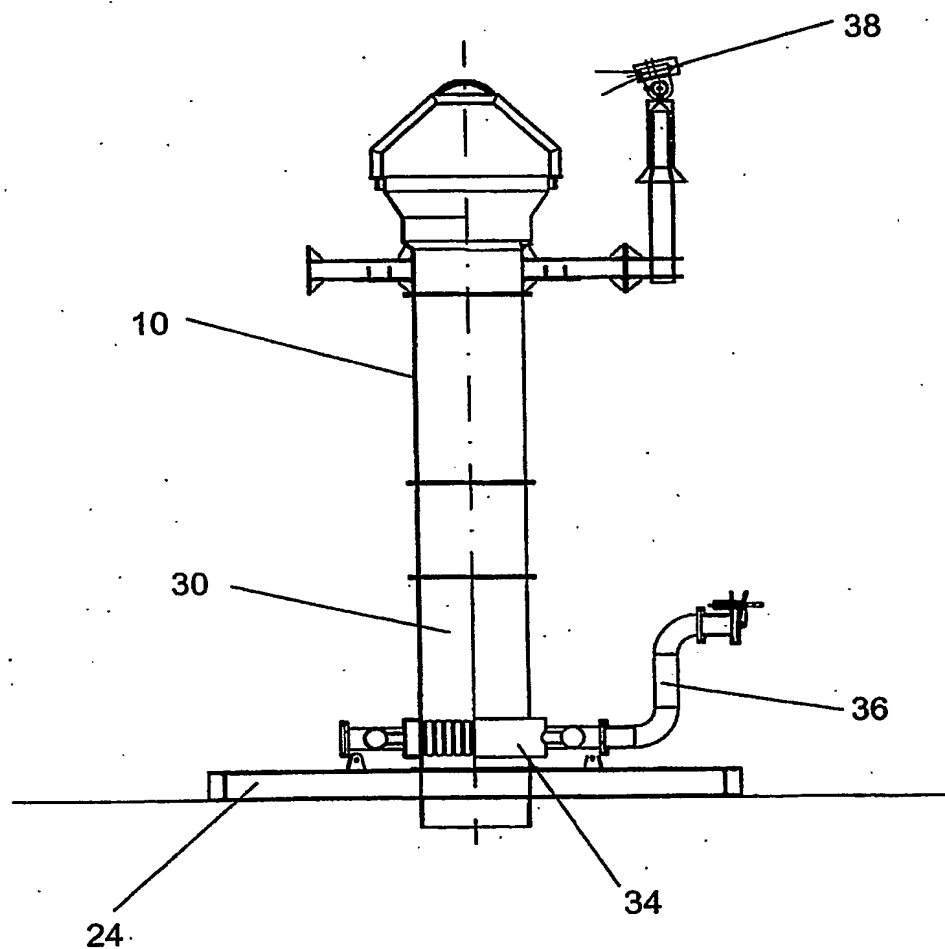


FIG. 4

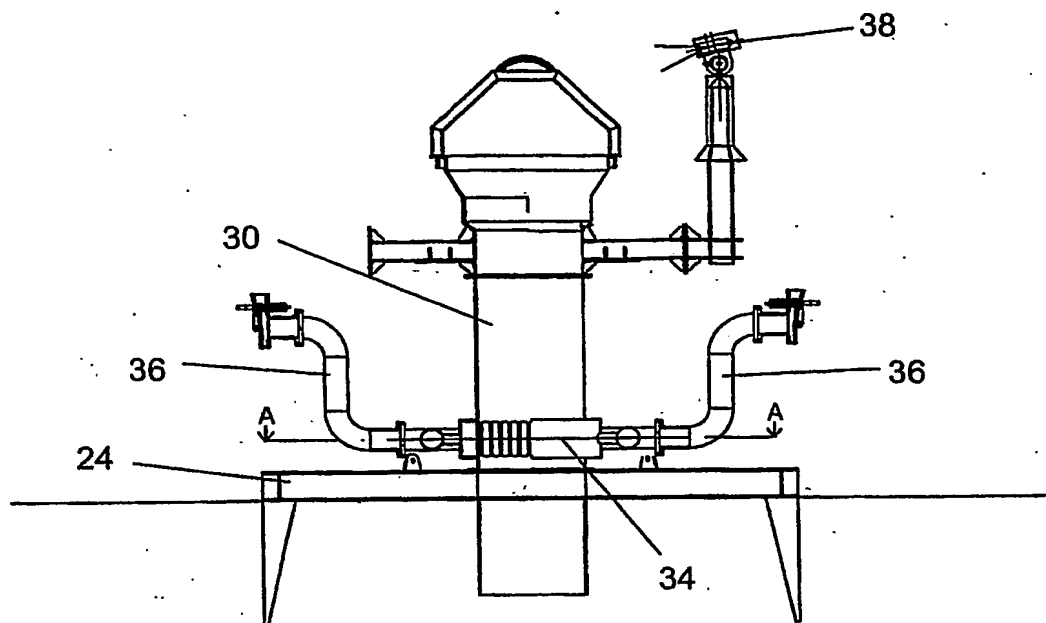
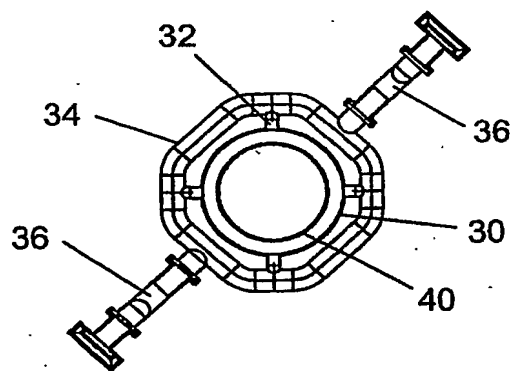


FIG. 4a



SECTION A-A

FIG. 4b

